

Student Reading 2 - *Understanding Nutrients: Questions and Answers*

The following is an excerpt from an article entitled “Too much of a good thing has led to Chesapeake’s nutrient woes” that appeared in the October 2002 issue of the Chesapeake Bay Journal. (<http://www.bayjournal.com/>)

The following series of questions and answers will help you to understand the issues that surround the eutrophication (or over-enrichment) due to an input of excess nutrients – both nitrogen and phosphorus.

How did nutrients get to be a problem?

It’s largely the fault of munitions built up for World War I and modern industrialization. For centuries, the amount of nitrogen available for use was relatively stable; animal waste was the main source of fertilizer. But during World War I, the Germans needed to increase their supply of nitrate, which is needed to make munitions explode. So they learned to tap an inexhaustible source: the atmosphere.

Nitrogen in the atmosphere is a stable gas which typically is not available for use by most plants. In the decades after the war, technology developed by the Germans was used to produce huge amounts of cheap, chemical fertilizers that were used in agriculture in increasing amounts. At the same time, industrialization led to the increased burning of fossil fuels, which release large amounts of long-stored nitrogen when burned.

Worldwide, it’s estimated that today there is about twice as much nitrogen in the environment than a century ago. In the Bay watershed, with its large human population and plenty of agricultural land, cars and power plants, there is anywhere from six to eight times as much nitrogen today than in the past.

Likewise, the amount of phosphorus has increased over historic levels. As with nitrogen, the amount of phosphorus on the landscape was once stable. But phosphorus is a mineral that can be mined from the ground, which has increased the amount available not only for fertilizers, but other purposes such as cleaning agents in detergents. (Although phosphates are banned in laundry detergents within most of the watershed, they are found in other cleaners such as dish soap and dishwasher detergent.)

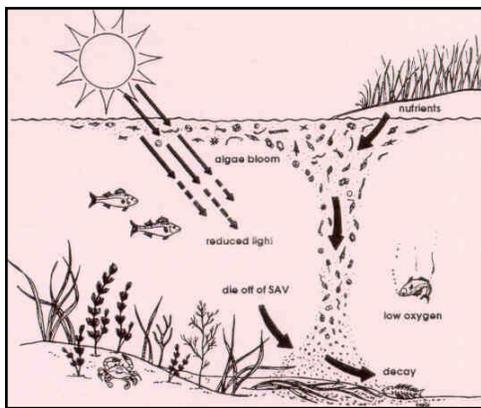


Figure 1. The results of excess nutrient input into an estuary. (reproduced from the U.S. Fish and Wildlife Service: <http://www.fws.gov/nc-es/edout/albenutrient.html>)

Why are nutrients a problem?

Excess nutrients over-fertilize the Bay, causing increased algae growth (Figure 1). Sometimes a single algae species becomes so dense that it forms a “bloom” which can actually change the color of the water. When algae cloud the water, they prevent underwater grass beds from getting the sunlight they need to survive. As a result, the grass beds — which provide food and habitat for crabs,

waterfowl and a host of fish species — occupy only a fraction of their historic range in the Bay.

When the algae die, they sink and are decomposed by bacteria in a process that rapidly uses up oxygen needed by fish and other water dwellers to survive. This is especially a problem in deep areas where oxygen can't be replenished from the air. In the summer, a third or more of the Bay's volume is typically rendered a "dead zone" because of oxygen depletion. Oxygen depletion caused by algae die-offs is also a problem in many shallow areas and tidal streams, although usually for shorter periods of time.

Blooms create added problems. Most zooplankton — an algae predator which in turn is an important food for fish and other species — require a mix of algae species to thrive. Frequent single species blooms can actually limit zooplankton production, reducing the amount of food available in the food chain leading to fish and crabs.

Further, some of those blooms can consist of harmful species that kill predators or, in some cases, affect human health. Lacking enough predators such as zooplankton to control the algae, the excess is eaten by oxygen-consuming bacteria. The Chesapeake is the most bacteria-enriched estuary known to exist in the United States. Some bacteria species that thrive in the Bay can affect the health of both humans and fish.

Nitrogen tends to fuel algae blooms in saltier portions of the Bay, while phosphorus is the main problem in low salinity and fresh water areas.

Aren't nutrients a good thing for plants and animals?

Yes. If it were not for nutrients, nothing would grow in the Bay. But the Bay has far more nutrients than it can handle. Compounding the problem is the Chesapeake and its watershed have lost much of their ability to absorb nutrients. The Bay was once filled with oysters that helped to filter excess algae from water. But today, oysters are at only about 1 percent of their historic levels because of disease and overharvesting. Menhaden, a filter-feeding fish, is also near historic lows in the Bay. In the watershed, the loss of nutrient-absorbing forests and wetlands also adds to the problem.

If we reduce nutrients, will all of the Bay's nutrient problems go away?

No. Nutrients are the most fundamental water quality issue for the Bay, but controlling nitrogen and phosphorus only sets the stage for the return of a healthy Chesapeake Bay. The recovery will also require major efforts to restore habitats, such as oyster reefs and underwater grass beds, and improved fisheries management to prevent the overfishing of critical species that are either commercially or ecologically valuable in the Bay.

Where do nutrients entering the Bay come from?

Agricultural runoff is the leading source, accounting for about two-fifths of both the nitrogen and phosphorus entering from the watershed (See Figures 2 and 3). Discharges from wastewater treatment plants are also a major source, followed by runoff from urban and suburban areas. Air pollution is also a big factor for nitrogen, with the combustion of fossil fuels and ammonia escaping livestock operations accounting for somewhere between a quarter and a third of the total.

Are nutrients a problem just in the Bay?

Absolutely not. A recent National Academy of Sciences report concluded that nutrient-related problems are “the greatest pollution threat faced by the coastal marine environment,” contributing to huge oxygen-depleted dead zones, harmful algae blooms, the loss of coral reefs and other problems. Because pollution control programs, in general, have not focused on nutrient issues, most coastal areas around the world face similar problems.

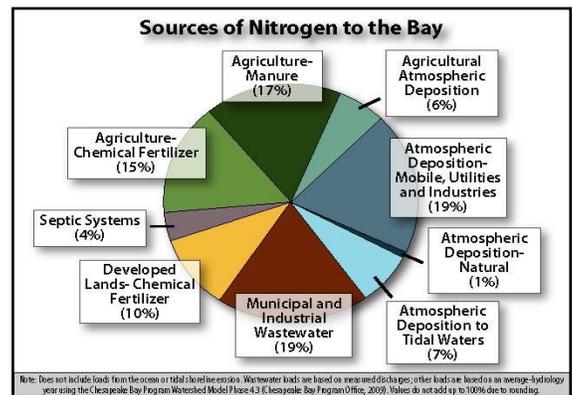


Figure 2. An estimate of nitrogen sources to the Chesapeake Bay based on the Chesapeake Bay Program Phase 4.3 Watershed Model 2007 Simulation and the Airshed Model. (reproduced from the Chesapeake Bay Program: <http://www.chesapeakebay.net>)

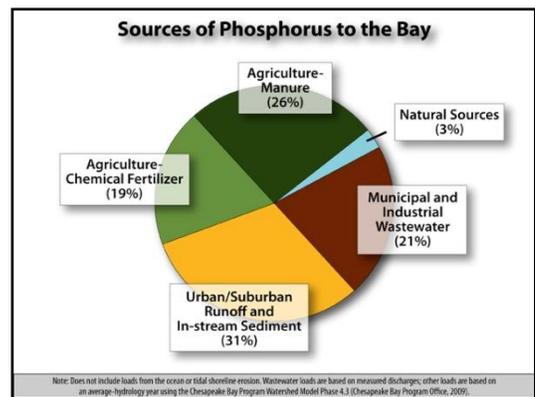


Figure 3. An estimate of nitrogen sources to the Chesapeake Bay based on the Chesapeake Bay Program Phase 4.3 Watershed Model 2007 Simulation. (reproduced from the Chesapeake Bay Program: <http://www.chesapeakebay.net>)